

TIME-SERIES ECONOMETRIC MODELING OF UNEMPLOYMENT AND GDP USING JMP

Client Profile:

The client was an economic research division of a South African university preparing a journal paper for submission to a regional economic policy conference. Their research focus was to examine whether GDP growth had any statistically significant effect on reducing unemployment in post-recession periods (2000–2022).

Client's Problem:

The client had quarterly GDP and unemployment data for South Africa, but faced three specific challenges:

1. They lacked clarity on whether their time series were stationary and could be used for OLS regression.
2. They were unsure about optimal lag structure and model type (VAR vs ARIMA).
3. They needed a technically sound yet readable report written in APA format with JMP outputs.

My Role:

- Time-Series Modeler (JMP)
- Report Architect (APA Style)
- Interpretation and Policy Advisor

Tools Used:

- JMP Pro
- Excel for raw data import
- Zotero for reference formatting (APA)

Phase 1 – Data Preparation and Transformation in JMP

- Imported quarterly data from 2000 Q1 to 2022 Q4 (92 observations).

- Checked data consistency and ensured quarterly dates were recognized in JMP's time index format.
- Converted Unemployment Rate and GDP Growth into logarithmic and differenced form to assess stability.

Phase 2 – Stationarity Testing and Lag Identification

- Conducted **ADF (Augmented Dickey-Fuller)** tests on each variable using custom formulas in JMP.
 - GDP Growth found stationary after first differencing.
 - Unemployment Rate required second differencing for stability.
- Used **Partial Autocorrelation Function (PACF)** and **Ljung-Box Q Tests** to determine optimal lag length (lag = 2).
- Verified no seasonal component existed, so deseasonalization was not applied.

Phase 3 – Model Selection: ARDL vs VAR vs ARIMA

- Ran initial **ARIMA(1,1,1)** and **ARIMA(2,1,0)** for unemployment rate modeling.
- Conducted Granger causality tests using lagged GDP growth as independent variable.
- Based on AIC and RMSE, selected **Autoregressive Distributed Lag (ARDL)** model with 2 GDP lags and 1 unemployment lag.

Phase 4 – Regression Execution and Diagnostics in JMP

- Performed full time-series regression in JMP using **Fit Model** platform with time-ordered lag terms.
- Residuals passed all diagnostic tests:
 - **No autocorrelation** (Durbin-Watson = 1.94)
 - **Homoscedasticity** confirmed using Breusch-Pagan test.
 - **No multicollinearity**, VIFs < 2 for all predictors.
- Confirmed adjusted $R^2 = 0.63$, indicating moderate explanatory power.

Phase 5 – Interpretation and Forecasting

- Interpreted each lagged variable with p-values, confidence intervals, and beta coefficients.
 - **Lag 1 of GDP Growth** was statistically significant ($p = 0.02$), suggesting delayed impact on unemployment.
- Generated **5-quarter forecast for Unemployment Rate**, visualized using **JMP Forecast Profiler**.
- Provided error bounds and best-case vs worst-case GDP scenarios using JMP's Simulation Add-in.

Phase 6 – Final Report and Delivery

- Delivered a **10-page APA-format report** with the following structure:
 - Introduction and Objectives (1 page)
 - Data Sources and Stationarity Checks (1.5 pages)
 - Model Comparison and Justification (2 pages)
 - Regression Results and Diagnostics (3 pages)
 - Forecast Visualization and Risk Scenarios (1.5 pages)
 - Policy Implications and Limitations (1 page)
- Included embedded JMP charts:
 - **Time Series Plot**
 - **Residual Plot**
 - **Forecast vs Actual**
 - **Effect Summary Plot**

Key Results & Takeaways:

Metric	Value
Adjusted R ²	0.63
Lag Significance	GDP Lag 1 ($p = 0.02$)

Model Type	ARDL
Forecast Horizon	5 Quarters
Format	APA report + JMP outputs
Delivery Time	7 days

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